

## **C3 Preliminary**

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#### Riprap placement on streambank

22 December 2006

The following figure is taken from page 35 of the Iowa DNR's manual *How to Control Streambank Erosion (updated 2006)*. The complete manual, including several pages that discuss riprap, may be downloaded from the following web site:

[http://www.iowadnr.gov/water/stormwater/forms/streambank\\_man.pdf](http://www.iowadnr.gov/water/stormwater/forms/streambank_man.pdf)

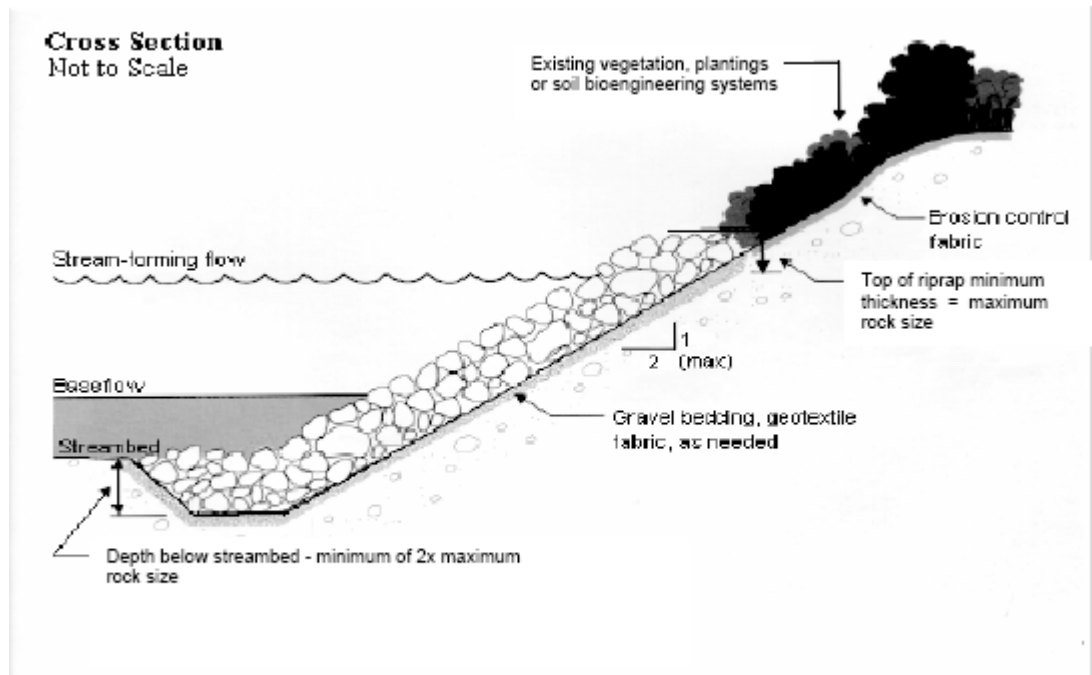


Figure 24. Cross-sectional view of riprap placement on the graded slope of a Streambank.

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#### **C3.2.6.1.6 PPCB**

#### **Methods Memo No. 159: Policy on Bulb Tee Use**

**1 June 2008**

With the release of the two new bulb tee sections, the 36 inch deep BTB and the 63 inch deep BTE, the Office of Bridges and Structures now has 4 bulb tee sections that can be used in bridge projects. The bulb tee beams that are now available are:

1. BTB (36 inches deep, spans 30 ft to 105 ft)
2. BTC (45 inches deep, spans 30 ft to 120 ft)
3. BTD (54 inches deep, spans 50 ft to 135 ft)
4. BTE (63 inches deep, spans 60 ft to 155 ft)

Note the longer beam spans will have limited beam spacing (less than 9'-3). The standard A through D (AASHTO Type) beams are still available and in general are preferred for economic reasons. When considering the use of a bulb tee section, the designer should consider the following:

1. Longer spans

For span lengths over 110 ft, the BTC, BTD and BTE should be considered along with a steel girder option. The 72 inch BT standards are void and no longer used in standard design.

2. Vertical clearances

For structures with vertical clearance problems where AASHTO type beams cannot be used, the BTB, BTC, and BTD should be considered along with a steel option.

3. Profile grade adjustments

- a. For replacement bridge projects where substantial cost increases are incurred with profile grade adjustments necessary to accommodate the AASHTO type beam, BTB, BTC, and BTD should be considered along with a steel option.
- b. For roadway alignments on relocation, costs associated with profile grade adjustments are generally considered part of the plan development process.

#### 4. High skews

The bulb tee standards are set up for skews of 30 degrees or less. Use of the bulb tees will require wider abutment and pier caps to accommodate the wide bottom flange (30 inches). For bridges with skews greater than 30 degrees, the designer should contact the supervising section leader.

#### 5. Estimated Haunch Limitations

When considering the use of bulb tee beams, take into account the geometrics of the roadway. On roadways with sharp vertical/horizontal curves, the longer bulb tee beams may not be feasible because of the large haunches and offsets that are associated with the longer spans (See Attachment "A" for pending Preliminary guidelines 3.2.6.3).

Use the estimated haunch equation (See attachment B) to determine if a bulb tee beam can be utilized. In cases where the estimated haunch limitations are exceeded because of vertical or horizontal curve issues noted above, other beam types and span arrangements should be considered.

#### 6. Longer spans for reducing piers

For longer bridges, the use of the longer span bulb tee beams can reduce the number of piers and may provide a more economical structure.

If you have any questions, please check with me.

**Attachment A (5 May 2009 - Text in the manual supersedes the two articles below.)**

### **3.2.6.3 Horizontal curve / 28 Feb 08**

If a bridge is to be placed along a horizontally curved alignment, the designer will need to decide how to configure the superstructure. For relatively insignificant curves, a superstructure may be constructed with straight beams or girders between locations of support, but for significant curves the beams or girders will need to be curved. The decision to require horizontally curved members generally limits the superstructure type and increases both final design and construction cost, so the designer needs to make the decision carefully.

The office has the following policy for horizontal curves. First, the designer shall determine the distance between the chord and arc, defined here as  $M$ , at the midpoint of the bridge. If  $M$  does not exceed 4 inches (100 mm), the bridge shall be designed on a chord at the designated full shoulder width. If  $M$  is larger than 4 inches (100 mm) but not larger than 12 inches (300 mm), before proceeding the designer shall consult with the supervising Section Leader. In most cases, for this intermediate curvature the bridge should be designed on a chord but slightly wider to provide full shoulder width or greater at all locations. If  $M$  is greater than 12 inches (300 mm), the bridge deck shall be designed on a horizontal curve.

If the bridge deck is to be constructed on a horizontal curve, the designer needs to consider the use of beams on chords or curved steel girders. When considering straight beams, the designer should check the offset for each span between the arc and chord. If any offset exceeds 9 inches (225 mm) a curved steel beam bridge should be considered.

In all cases, whether the bridge is designed on a chord or on a curve, the designer shall label stationing of bridge details from the centerline of the approach roadway. The stationing should be referenced from the centerline of the construction survey.

#### **3.2.6.3.1 Spiral curve / 28 Feb 08**

The use of spiral curves in roadways in Iowa is an accepted practice to improve alignment and safety. In order to minimize the effects of complicated roadway geometry on bridges, spiral curves will either be moved off the bridge or eliminated from use in order to simplify design and construction.

**Attachment B**

Preliminary haunch for all Prestressed Beam Bridges

Note: The calculations provide a haunch thickness estimate (X) value, which doesn't include the nominal haunch thickness.

$S := 111.5 \text{ ft}$  Longest Span (feet)

$e := 0.02$  Superelevation (feet/feet)

$G_1 := -1.6\%$  Grade 1 vertical curve [+ increasing, - decreasing] (%)

$G_2 := 2.1\%$  Grade 2 vertical curve [+ increasing, - decreasing] (%)

$A := \frac{G_2 - G_1}{100}$   $A = 0.038$

$L := 984 \text{ ft}$  Length vertical curve (feet)

$D_c := 1.75 \text{ deg}$  Degree of Horizontal Curvature (degree)

$C := 0.337 \text{ ft}$  Final Beam Camber (feet) - From prestressed concrete beam standards

$D := 0.19 \text{ ft}$  Dead load deflection - Elastic + 1/2 Plastic (feet) - From prestressed concrete beam standards

$T := 1.667 \text{ ft}$  Top flange width (feet)

X = Haunch estimate along the centerline of the beam.

$$X := (C - D) + \frac{S \cdot e}{2} \cdot \left( \frac{1}{\sin\left(\frac{D_c}{2}\right)} - \frac{1}{\tan\left(\frac{D_c}{2}\right)} \right) + \left( \frac{S}{L} \right)^2 \cdot A \cdot \frac{L}{8}$$

$X = 0.219 \text{ ft}$        $X = 66.894 \text{ mm}$

~~~~~      ~~~~~

$$T \cdot e = 0.6 \text{ in}$$

If  $T \cdot e < 1$  then  $X < 4 \text{ in.}$       If  $T \cdot e > 1$  then  $X < 3 \text{ in.}$

Also check maximum offset for horizontal curve  $\leq 9 \text{ in.}$

### **C3.2.6.1.7 CWPG**

### **C3.2.6.2 Width**

#### **C3.2.6.2.1 Highway**

#### **C3.2.6.2.2 Sidewalk, separated path, and bicycle lane**

##### **Methods Memo No. 11: Sidewalks on Bridges**

**21 March 2001**

When placing sidewalks on bridges, the following policy should be used for determining whether to use raised sidewalks or sidewalks at grade.

1. Raised sidewalks, which allow water to drain through slots in the separation barrier curb to the bridge gutterline, shall be used on highway and railroad overpasses.
2. All other situations may use an at grade sidewalk which allows the water to drain over the slab edge.

At grade sidewalks, which drain the water back towards the gutter line, shall not be used. The reason the office would like to avoid this condition is that it would require the exterior girder to be placed higher than the adjacent interior girder. In addition, in situations of excessive rainfall the sidewalks may be temporarily flooded because of water from the roadway. Superelevated bridges may require special considerations. Check with your section leader in this case.

Regardless of the sidewalk type, the top of the slab where the chain link fence is attached shall be made level and drip grooves shall be used on the underside of the slab.

### **C3.2.6.3 Horizontal curve**

#### **C3.2.6.3.1 Spiral curve**

#### **C3.2.6.4 Alignment and profile grade**

##### **Methods memo No. 85: Layout for Bridges on Four Lane Highways**

**30 January 2004**

Based on comments from the field, please use the following guidelines when developing details for bridges on four lane divided highways.

1. Do not use the term "Centerline of Bridge Roadway" in the plans.
2. On the staking diagram, show all measurements off "Centerline of Approach Roadway". The "Centerline of the Profile Grade Line" may be shown on the staking diagram but must not be referenced to the "Centerline of Approach Roadway".
3. Show the "Profile Grade Line" on the Situation Plan and on the Top of Slab Elevation sheet.
4. In the bridge plans designate the bridge centerline as "Centerline of Bridge", "Centerline of Abutment", "Centerline of Pier". Details should also include "Centerline of Approach Roadway" and the offset to the centerline of the bridge unit.
5. Stations on the "Situation Plan" view should be based on the "Centerline of Approach Roadway". The elevations shown in the "Longitudinal Section Along Centerline of Approach Roadway" should coincide with the stations shown in the "Situation Plan" view.



### **C3.2.6.5 Cross slope drainage**

### **C3.2.6.6 Deck drainage**

**Methods Memo No. 81: Deck Drains**  
**24 March 2005**

See C5.2.4.1.2.

### **C3.2.6.7 Bridge inspection/maintenance accessibility**

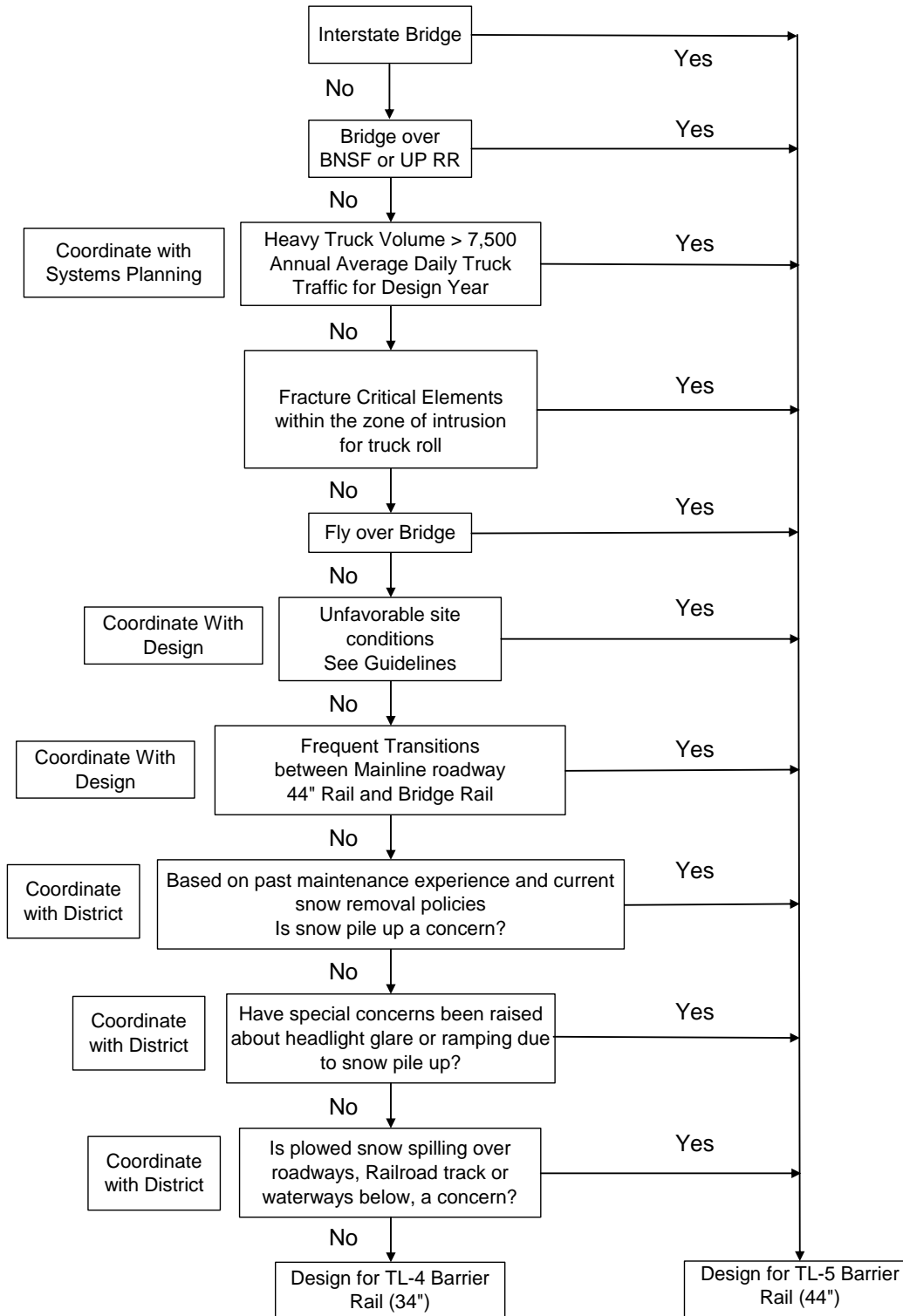
### **C3.2.6.8 Barrier rails**

**Methods Memo No. 162: Bridge Railing Selection on Interstate and Primary Highways**  
**29 June 2007**

See C5.8.1.2.1 for the memo text. The flow chart (**with revisions dated 5 May 2009**) is reproduced on the next page.

## Flow Chart for determining Bridge Barrier Rail Height for New Bridges on Interstate and Primary Highways

Revised 5 May 2009



## **C3.2.7 Substructures**

### **C3.2.7.1 Skew**

### **C3.2.7.2 Abutments**

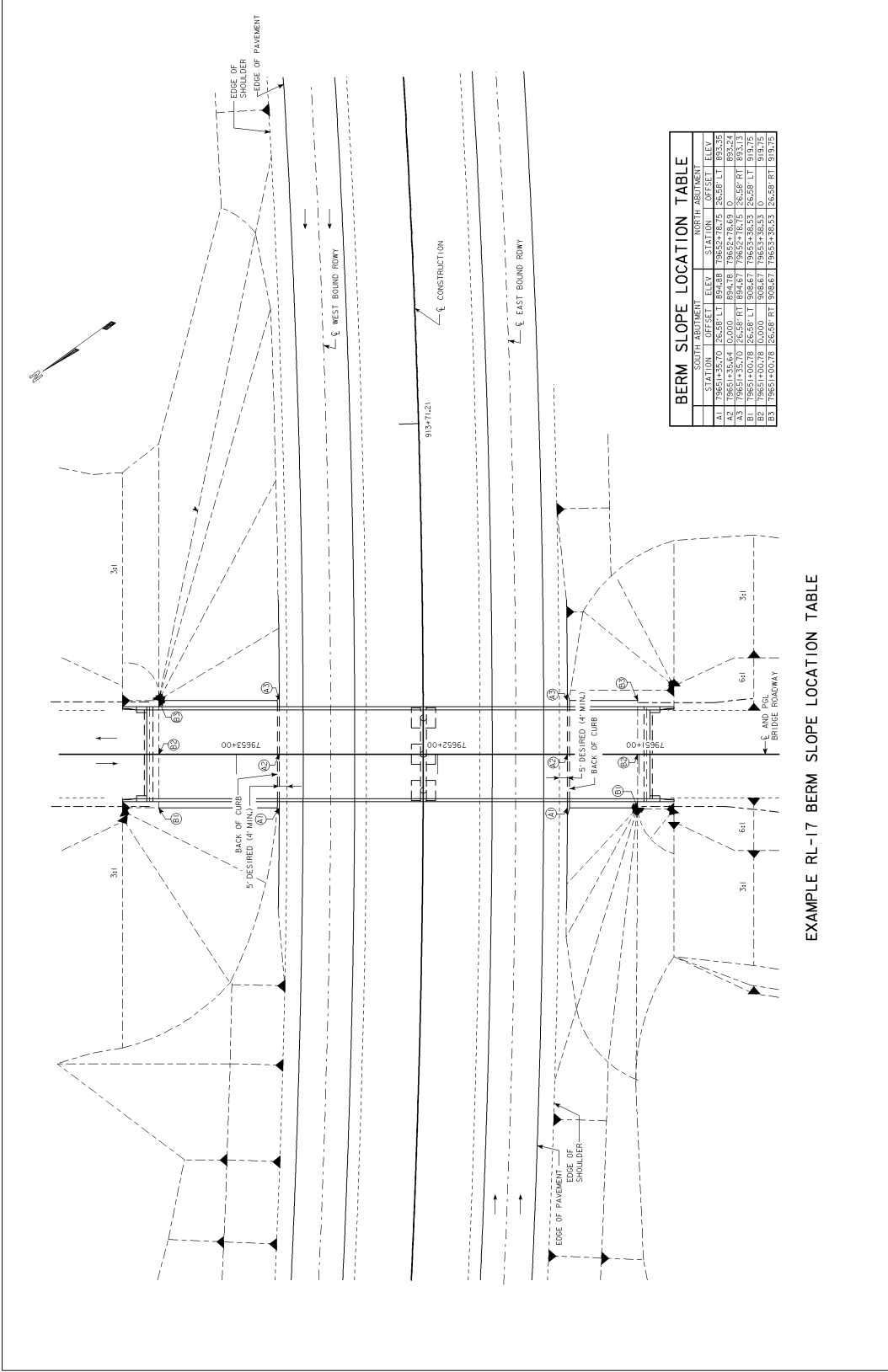
### **C3.2.7.3 Berms**

#### **C3.2.7.3.1 Slope**

#### **C3.2.7.3.2 Toe offset**

#### **C3.2.7.3.3 Berm slope location table**

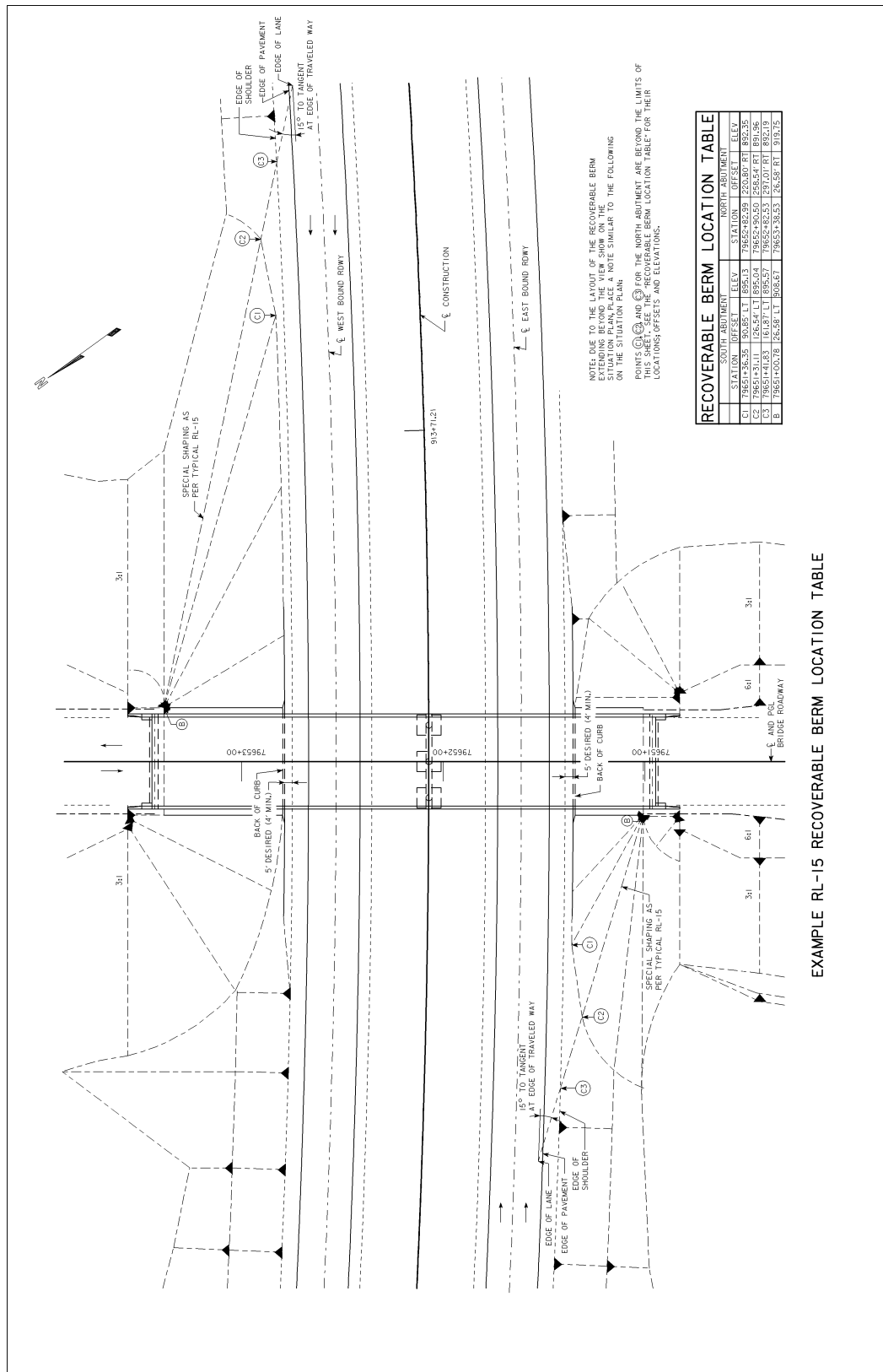
See also the RBLT example C3.2.7.3.4.



EXAMPLE RL-17 BERM SLOPE LOCATION TABLE

### C3.2.7.3.4 Recoverable berm location table

See also the BSLT example in C3.2.7.3.3.



EXAMPLE RL-15 RECOVERABLE BERM LOCATION TABLE

### **C3.2.7.3.5 Slope protection**

### **C3.2.7.4 Piers and pier footings**

### **C3.2.8 Cost estimates**

### **C3.2.9 Preliminary situation plans**

### **C3.2.10 Permits and approvals**

#### **C3.2.10.1 Waterway**

##### **Department of Natural Resources List of Meandered Streams 22 December 2006**

Iowa Department of Natural Resources Sovereign Lands Construction Permits are required for work on or over meandered streams. (This is a different permit than a Floodplain Development Permit.) The term “meandered stream” for this permit is a legal description where the State of Iowa owns the stream bed and banks of certain reaches of rivers. A meandered stream is one which at the time of the original government survey was so surveyed as to mark, plat and compute acreage of adjacent fractional sections. DNR is responsible for this state-owned land and therefore issues a Construction Permit. The following is a list of the descriptions of the limits of these rivers in the state of Iowa.

1. Des Moines River. From Mississippi River to the junction of the east and west branches. The west branch to west line T95N, R32W, Palo Alto County, due south of Emmetsburg. The east branch to north line T95N, R29W, Kossuth County, near the north edge of Algona.
2. Iowa River. From Mississippi River to west line T81N, R11W, Iowa County, due north of Ladora.
3. Cedar River. From Iowa River to west line T89N, R13W, Black Hawk County, at the east edge of Cedar Falls.
4. Raccoon River. From Des Moines River to west line of Polk County.
5. Wapsipinicon River. From Mississippi River to west line T86N, R6W, Linn County northwest of Central City.
6. Maquoketa River. From Mississippi River to west line T84N, R3E Jackson County, due north of Maquoketa.
7. Skunk River. From Mississippi River to north line of Jefferson County, at the southwest edge of Coppock.
8. Turkey River. From Mississippi River to west line T95N, R7W, Fayette County, northwest of Clermont.
9. Nishnabotna River. From Missouri River to north line T67N, R42W, Fremont County, northeast of Hamburg.
10. Upper Iowa River. From Mississippi River to west line Section 28, T100N, R4W, Allamakee County, about two and one-half miles upstream from its mouth.

11. Little Maquoketa River. From Mississippi River to west line Section 35, T90N, R2E, Dubuque County, about one mile upstream from its mouth.
12. Mississippi River, Missouri River, Big Sioux River.

### **C3.2.10.2 Railroad**

### **C3.2.10.3 Highway**

### **C3.2.11 Forms**